

# Theory of the Firm

Costs & Product (mostly short run)

- Privately owned firms will be motivated by profit.
- Total Profit = Total Revenue ( $P \times Q$ ) minus Total Cost
- Total Profit =  $TR - TC$

# Production Function



- **short run:** the time period when at least one factor of production is fixed.
- **long run:** the time period when all factors of production can be changed.

# Law of Diminishing Returns

- In the short run, at least one factor of production is fixed, and at least one is variable.
- If a firm wants to increase product (output), it can add more of the variable factor of production.
- Each additional unit of the variable factor has less and less of the fixed factor to work with.

- Example...
  - If a TV studio wants to increase the number of shows it broadcasts, and hires more staff but cannot increase the studio floor space, the workers have less and less floor space to use.
- Can you think of an example?

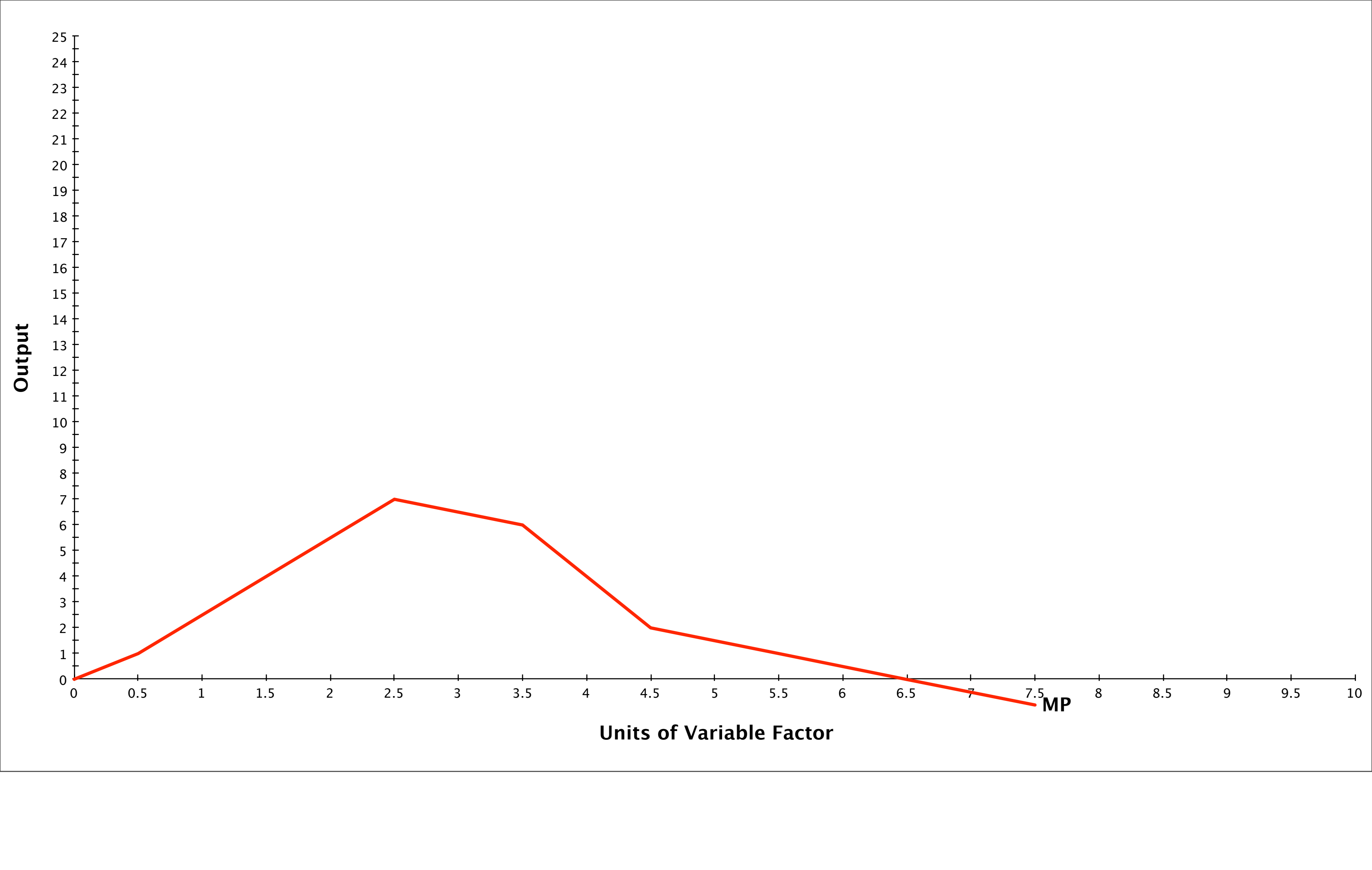
- **Law of Diminishing Returns:** if some factors of production are increased while at least one other input remains fixed, then at some point the additional output (product) for each additional variable factor will decrease.
- In the short run, marginal product (output) will decrease at some point.
- Diminishing returns will occur because each additional unit of input has less and less of the fixed input to combine with.

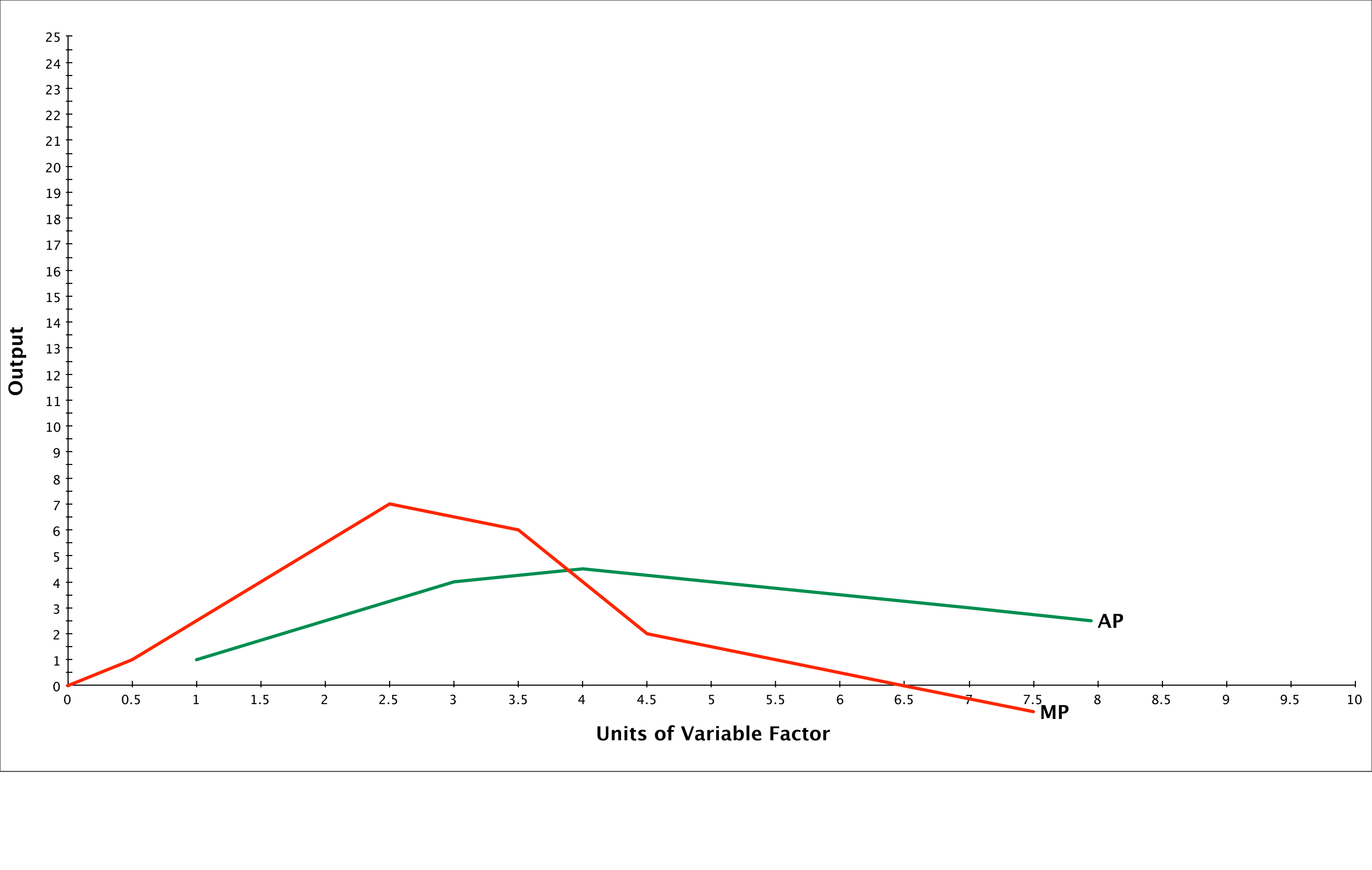
# Total Product, Average Product, and Marginal Product

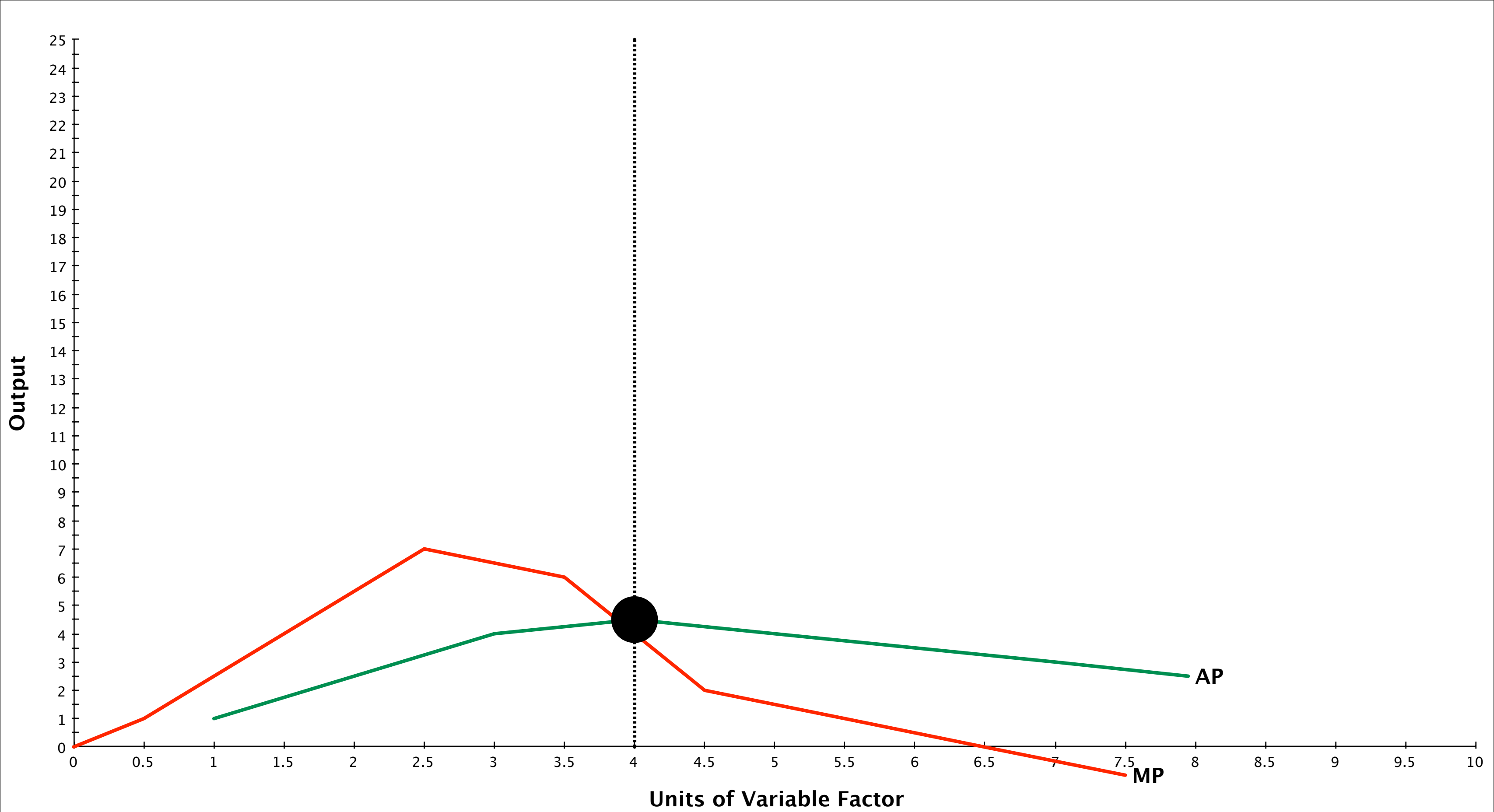
- **Total Product (TP)** = the total quantity, or total output, of a particular good or service produced.
- **Average Product (AP)** =  $TP / \text{units of factor input}$
- **Marginal Product (MP)** =  $\Delta \text{ in TP} / \Delta \text{ in factor input}$



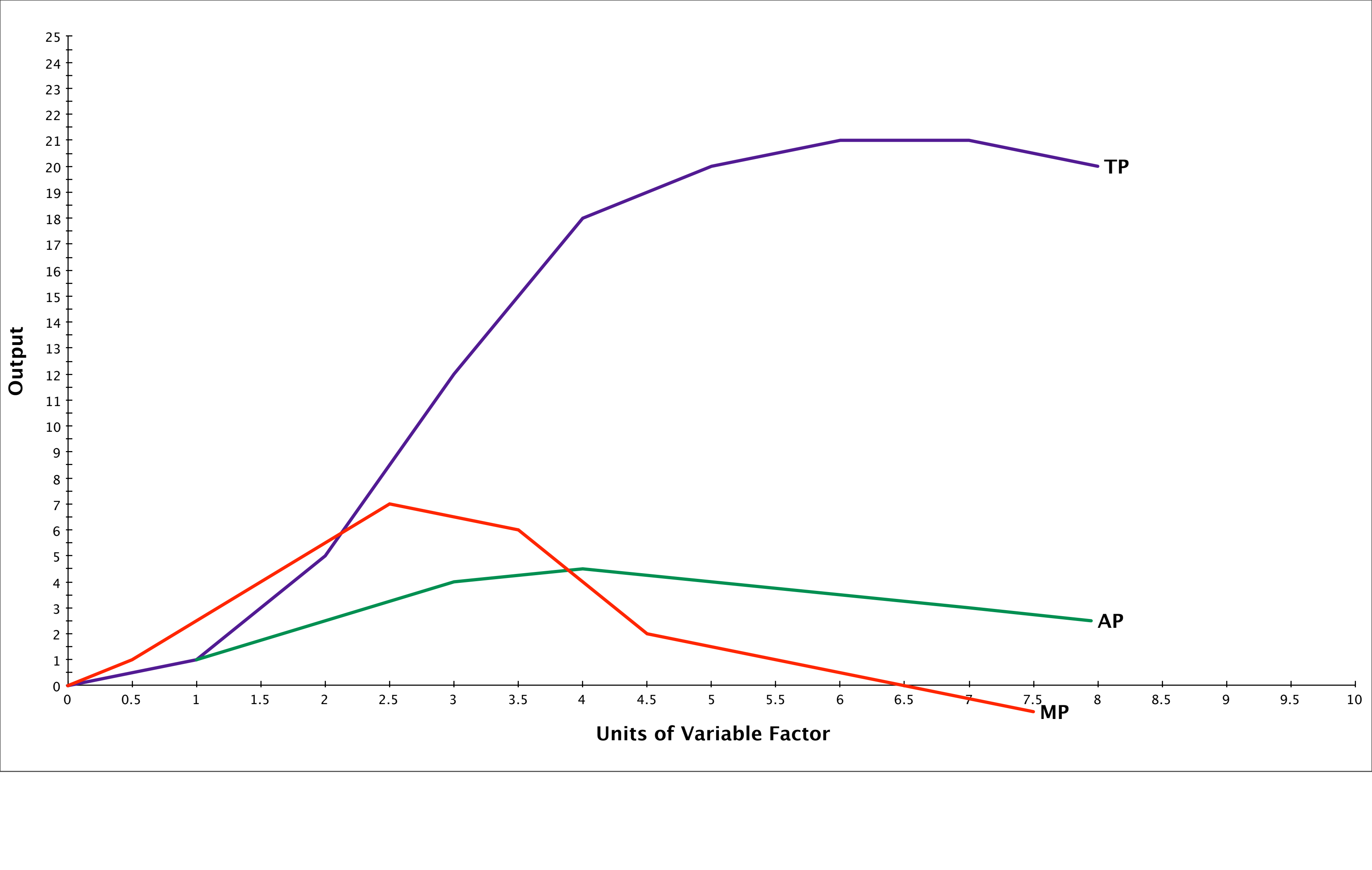
| #Variable Factor | TP | AP  | MP |
|------------------|----|-----|----|
| 0                | 0  | -   |    |
| 1                | 1  | 1.0 | 1  |
| 2                | 5  | 2.5 | 4  |
| 3                | 12 | 4.0 | 7  |
| 4                | 18 | 4.5 | 6  |
| 5                | 20 | 4.0 | 2  |
| 6                | 21 | 3.5 | 1  |
| 7                | 21 | 3.0 | 0  |
| 8                | 20 | 2.5 | -1 |
|                  |    |     |    |

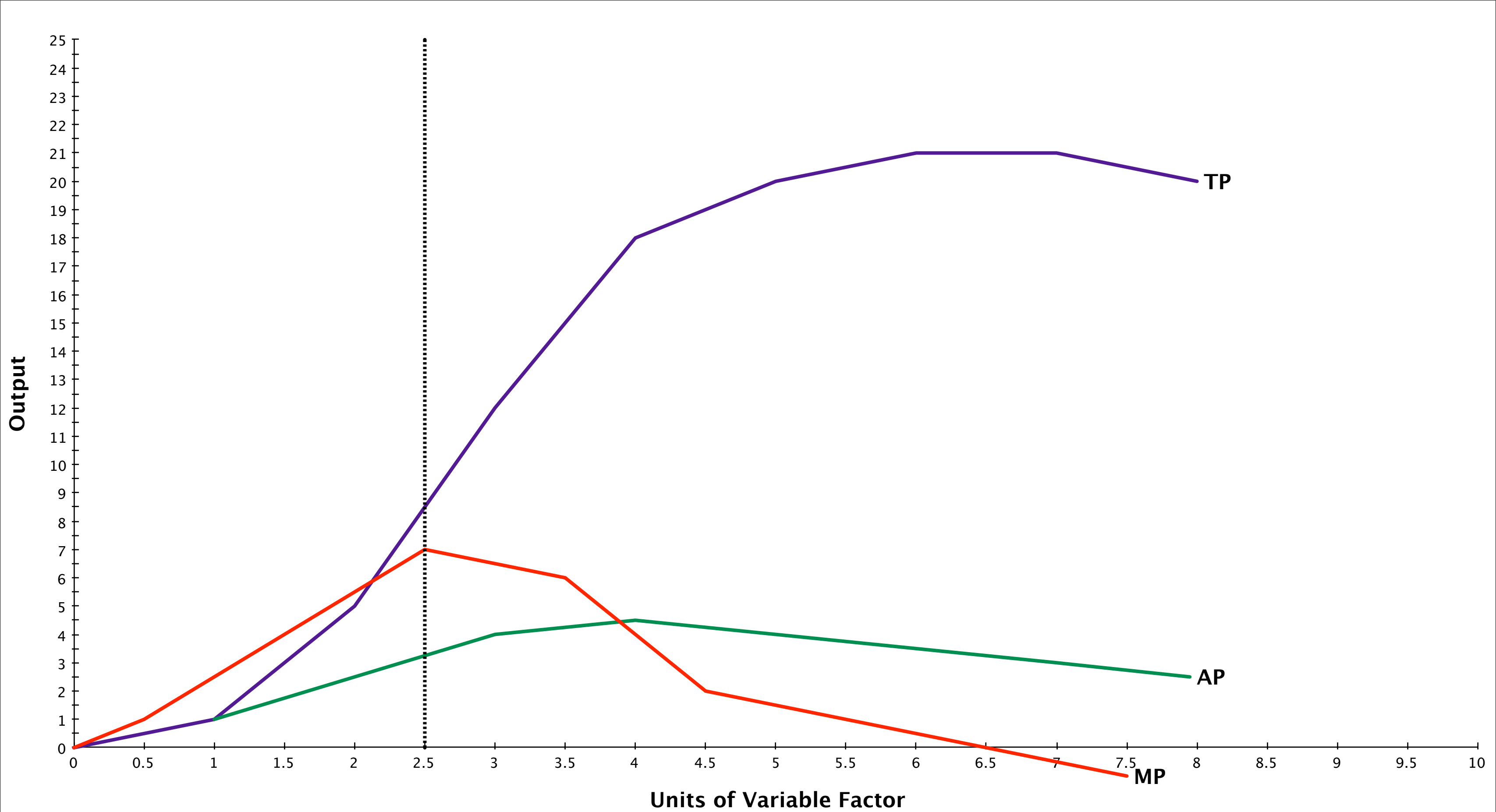




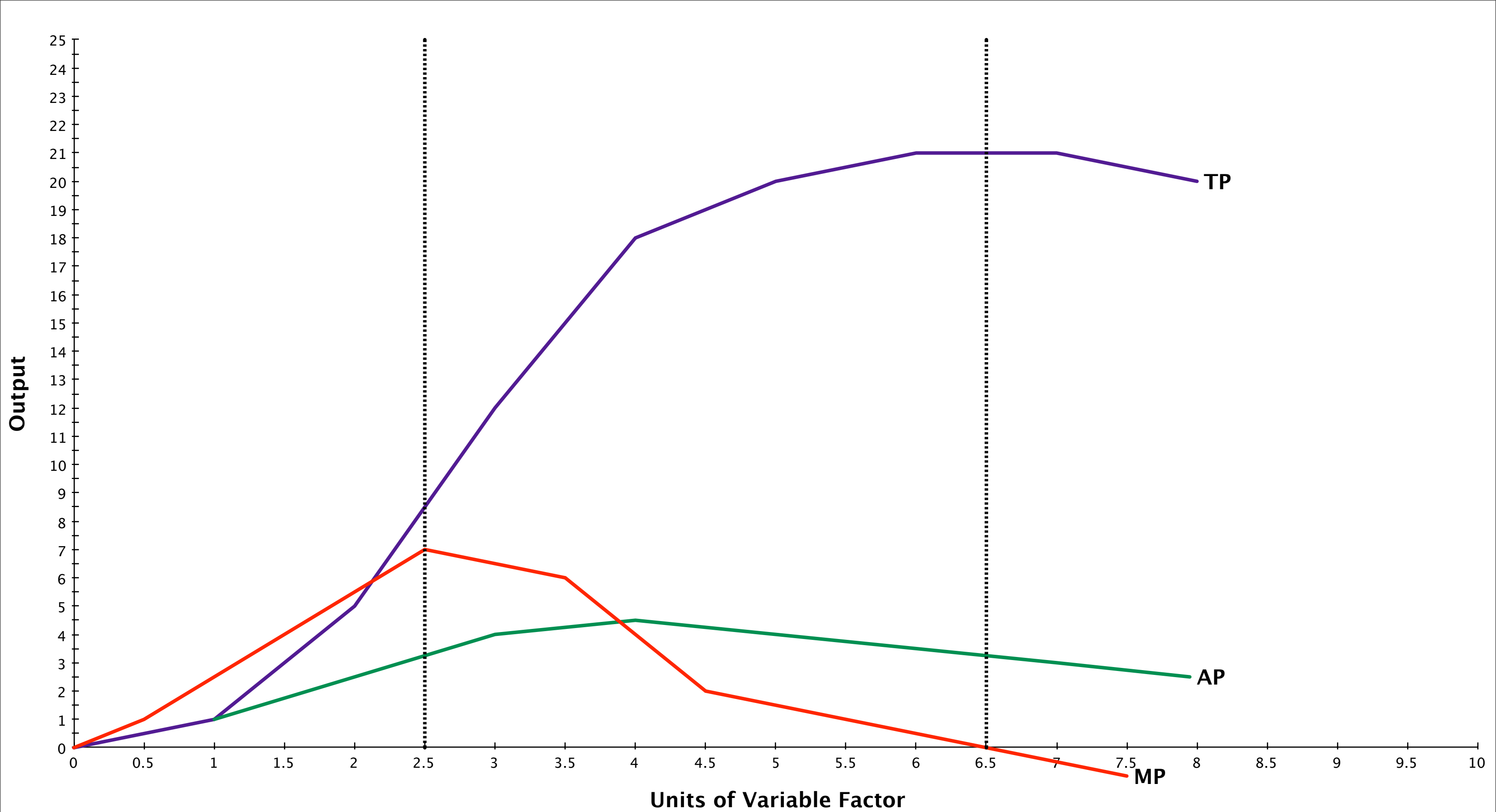


MP crosses AP at its maximum.

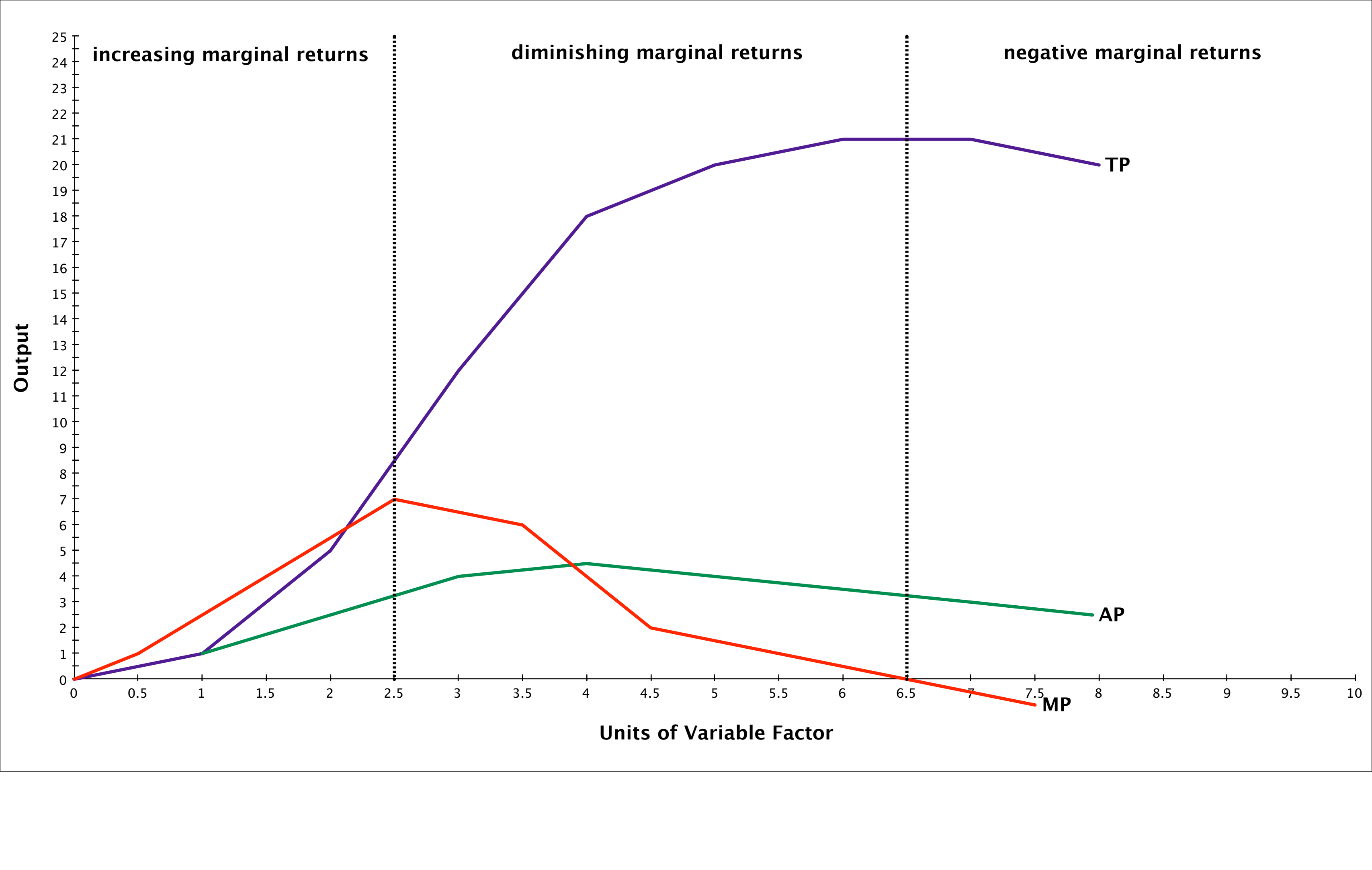




This is the point of diminishing marginal returns!  
This is when TP begins increasing at a decreasing rate!



This is when MP is zero!  
After this point, TP decreases!





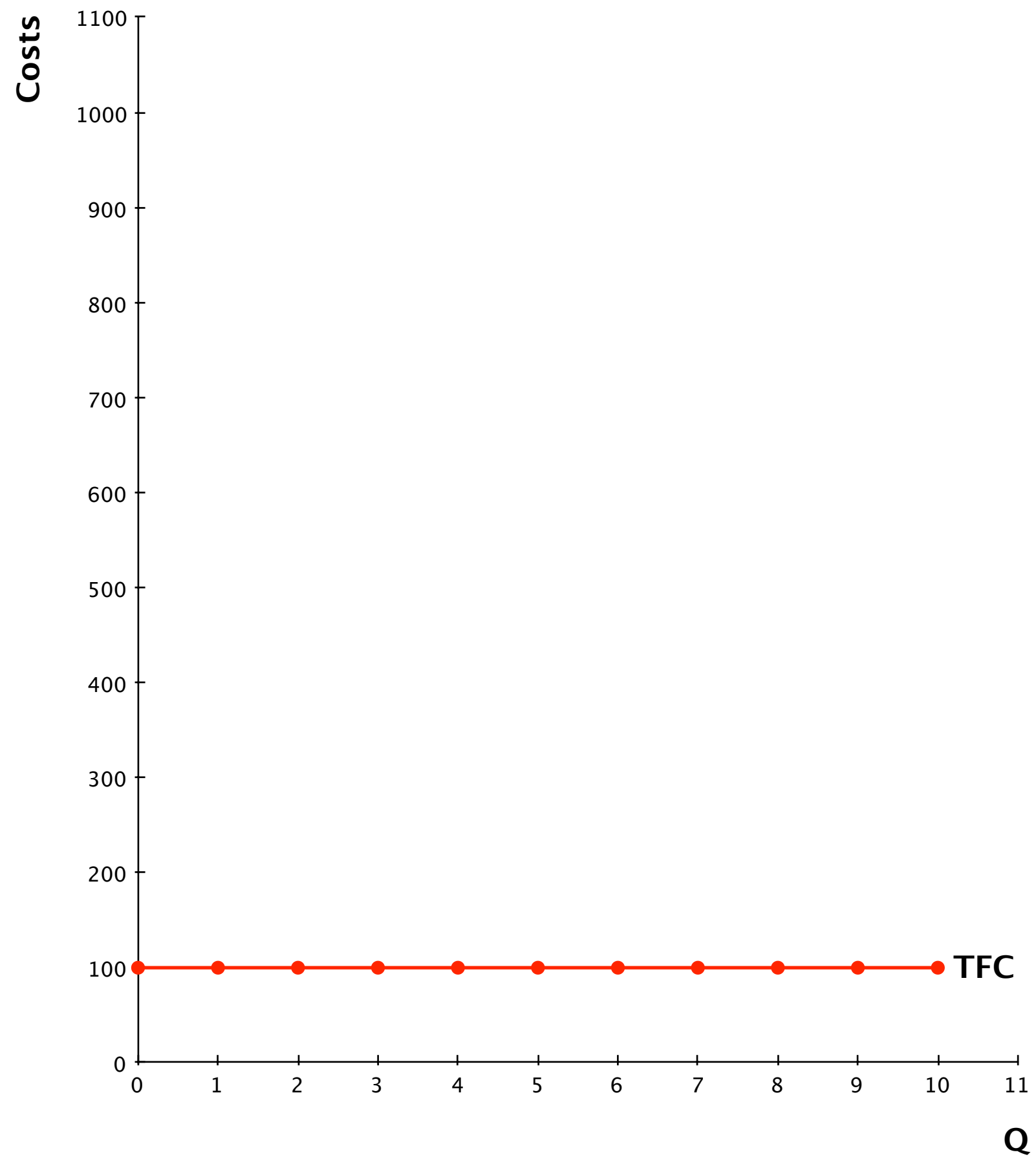
# Short Run Costs

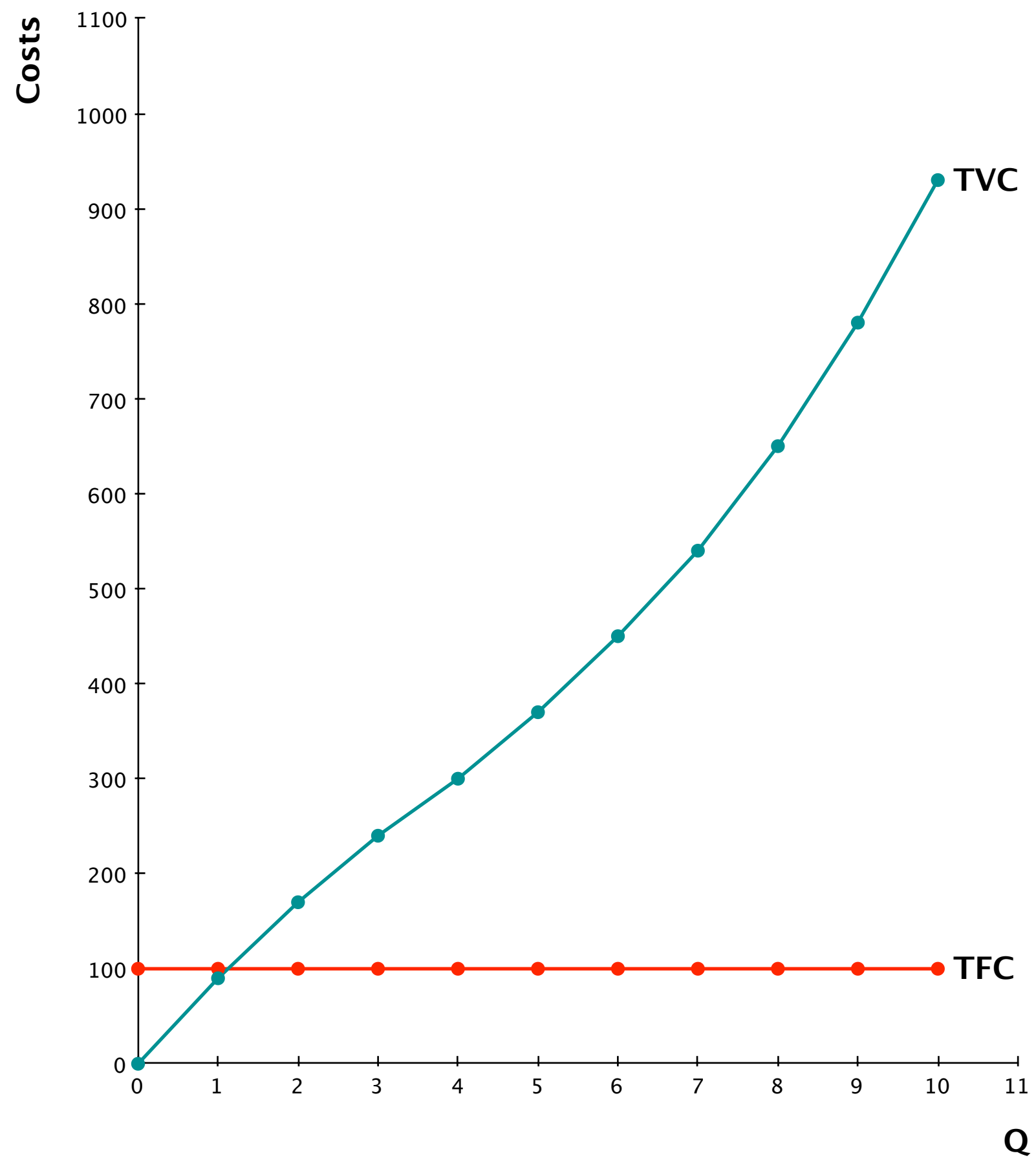
- Short run costs are determined by the fact that at least one factor of production is fixed.
- Total Cost = Total Fixed Cost + Total Variable Cost
- $TC = TFC + TVC$

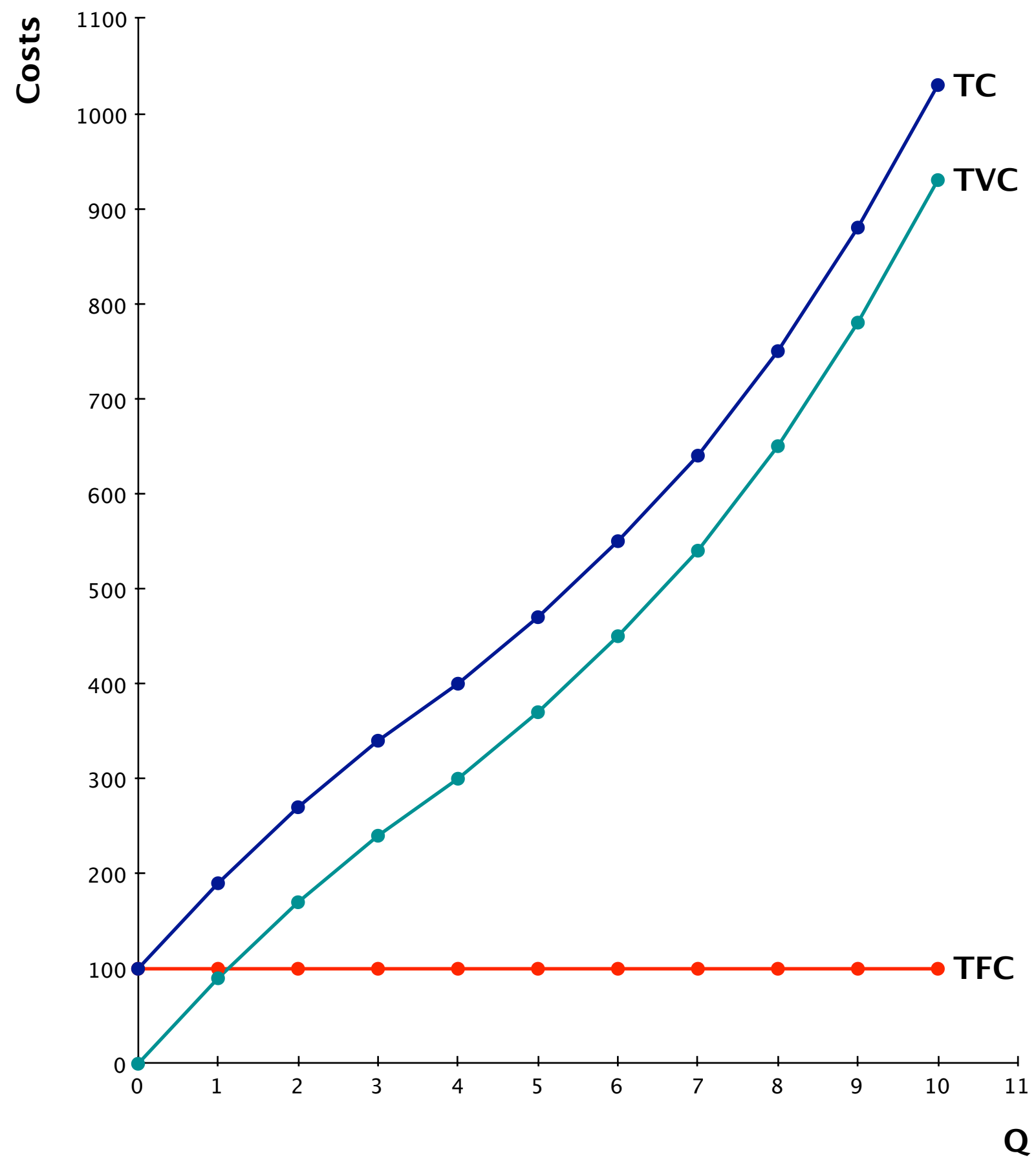
- **Fixed cost:** costs which have to be paid regardless of the firm's level of production.
  - Fixed cost does not change with output.
- **Variable cost:** costs which change with output.

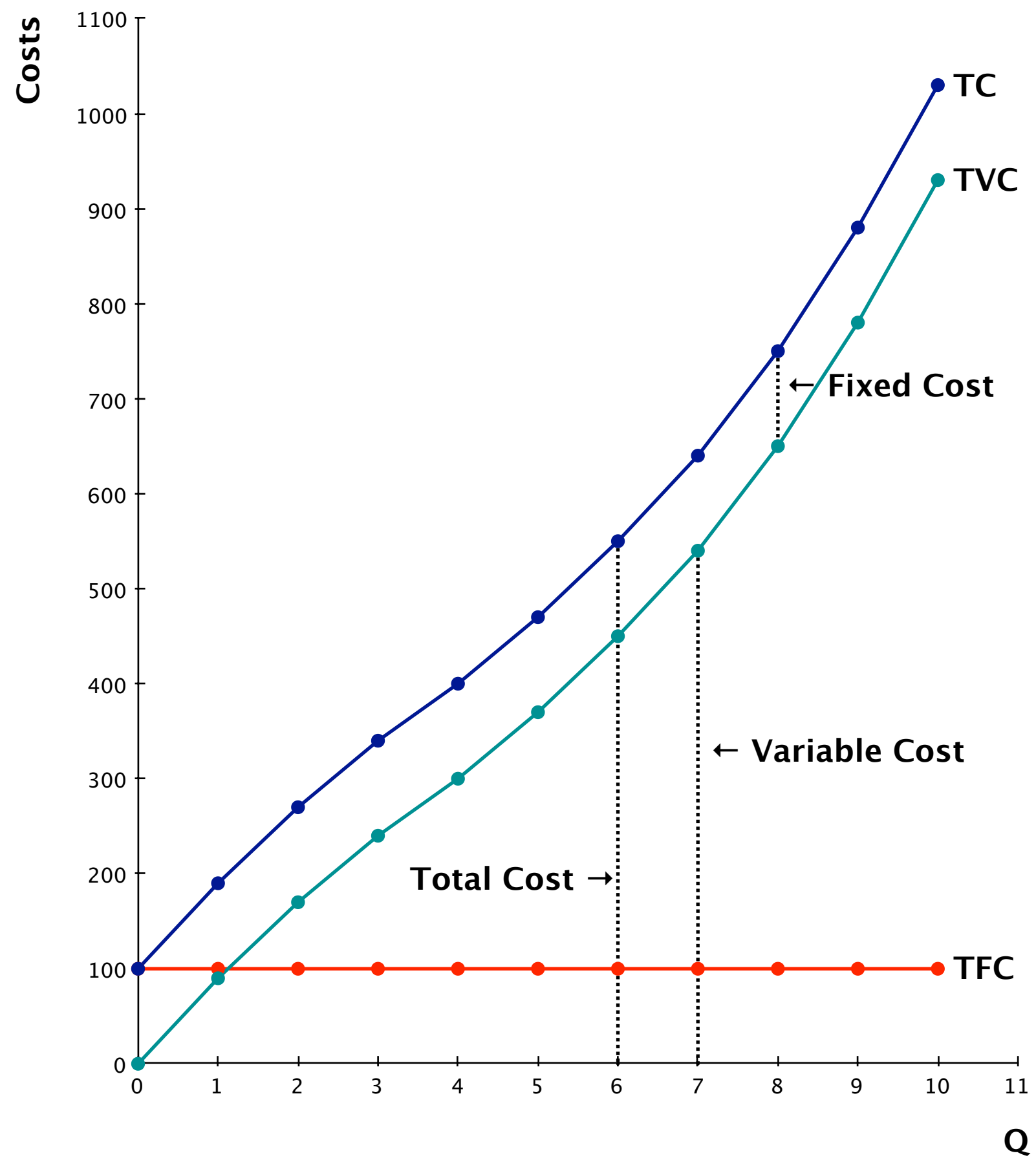
- **Average Fixed Cost (AFC)** =  $TFC / Q$
- **Average Variable Cost (AVC)** =  $TVC / Q$
- **Average Total Cost (ATC)** =  $TC / Q = (TFC/Q) + (TVQ/Q) = AFC + AVC$
- **Marginal Cost** =  $\Delta TC / \Delta Q$

|    | Total Cost Data |     |      | Average Cost Data |       |        |     |
|----|-----------------|-----|------|-------------------|-------|--------|-----|
| Q  | TFC             | TVC | TC   | AFC               | AVC   | ATC    | MC  |
| 0  | 100             | 0   | 100  | -                 | -     | -      |     |
| 1  | 100             | 90  | 190  | 100.00            | 90.00 | 190.00 | 90  |
| 2  | 100             | 170 | 270  | 50.00             | 85.00 | 135.00 | 80  |
| 3  | 100             | 240 | 340  | 33.33             | 80.00 | 113.33 | 70  |
| 4  | 100             | 300 | 400  | 25.00             | 75.00 | 100.00 | 60  |
| 5  | 100             | 370 | 470  | 20.00             | 74.00 | 94.00  | 70  |
| 6  | 100             | 450 | 550  | 16.67             | 75.00 | 91.67  | 80  |
| 7  | 100             | 540 | 640  | 14.29             | 77.14 | 91.43  | 90  |
| 8  | 100             | 650 | 750  | 12.50             | 81.25 | 93.75  | 110 |
| 9  | 100             | 780 | 880  | 11.11             | 86.67 | 97.78  | 130 |
| 10 | 100             | 930 | 1030 | 10.00             | 93.00 | 103.00 | 150 |
|    |                 |     |      |                   |       |        |     |

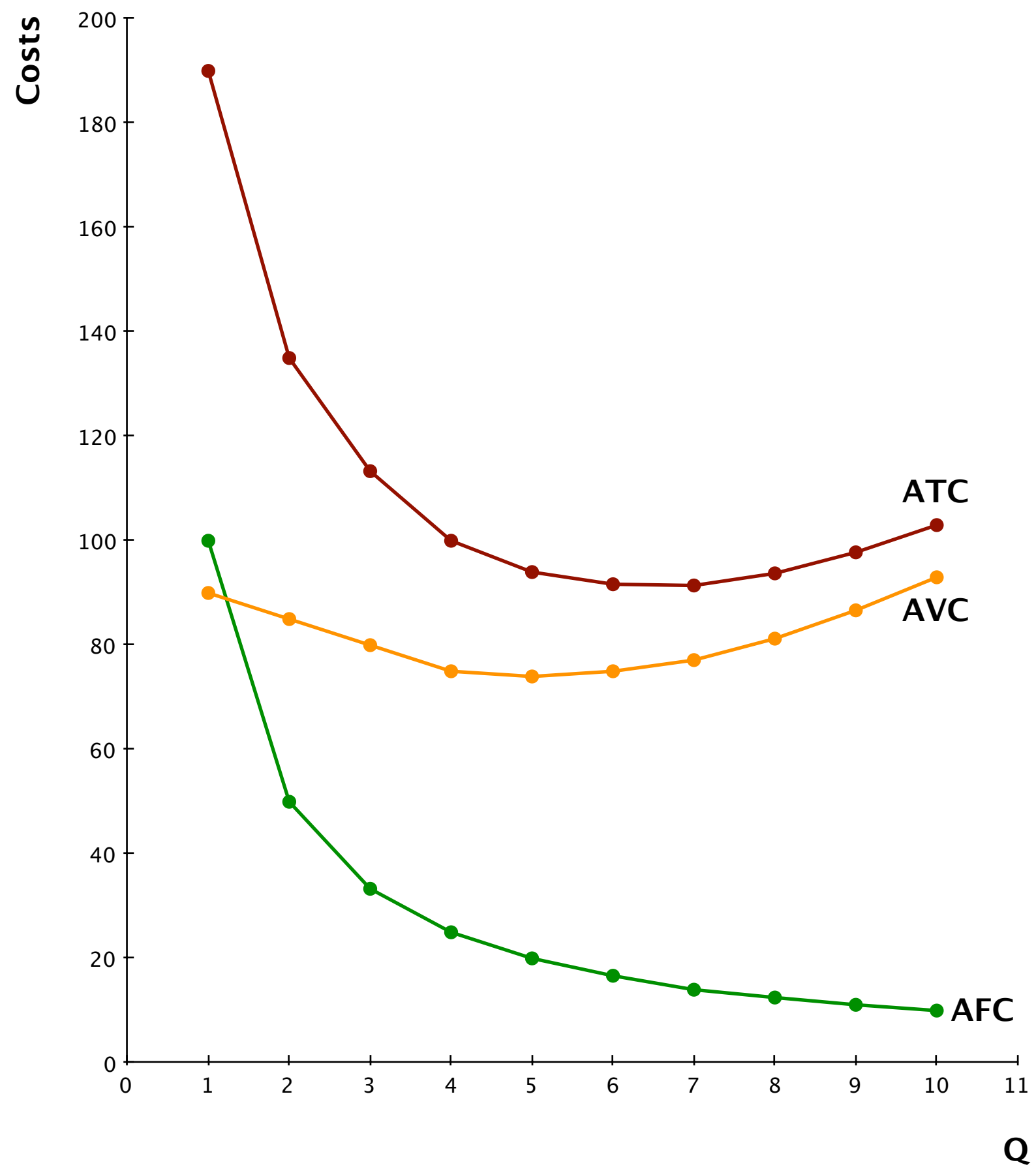


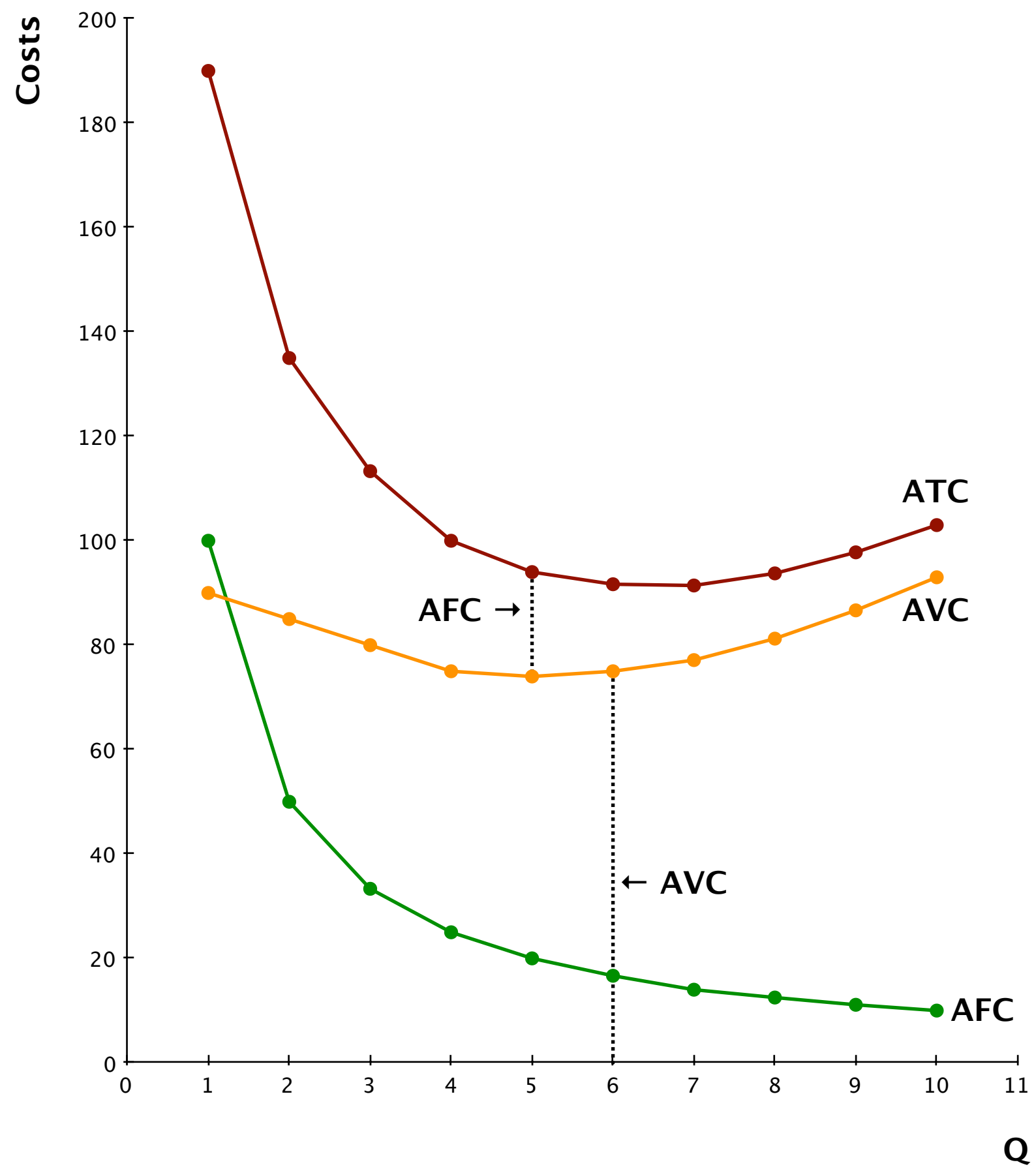


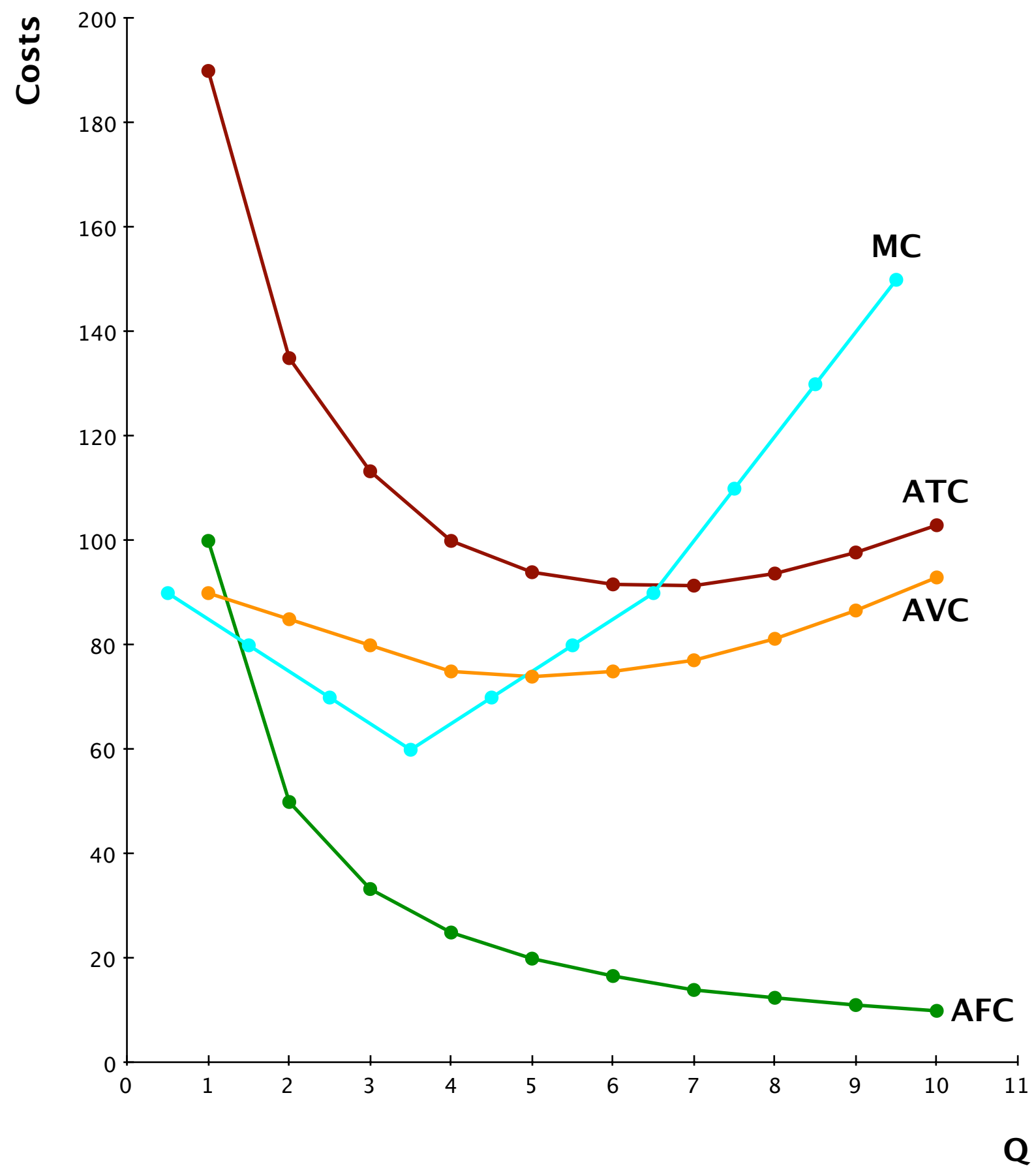




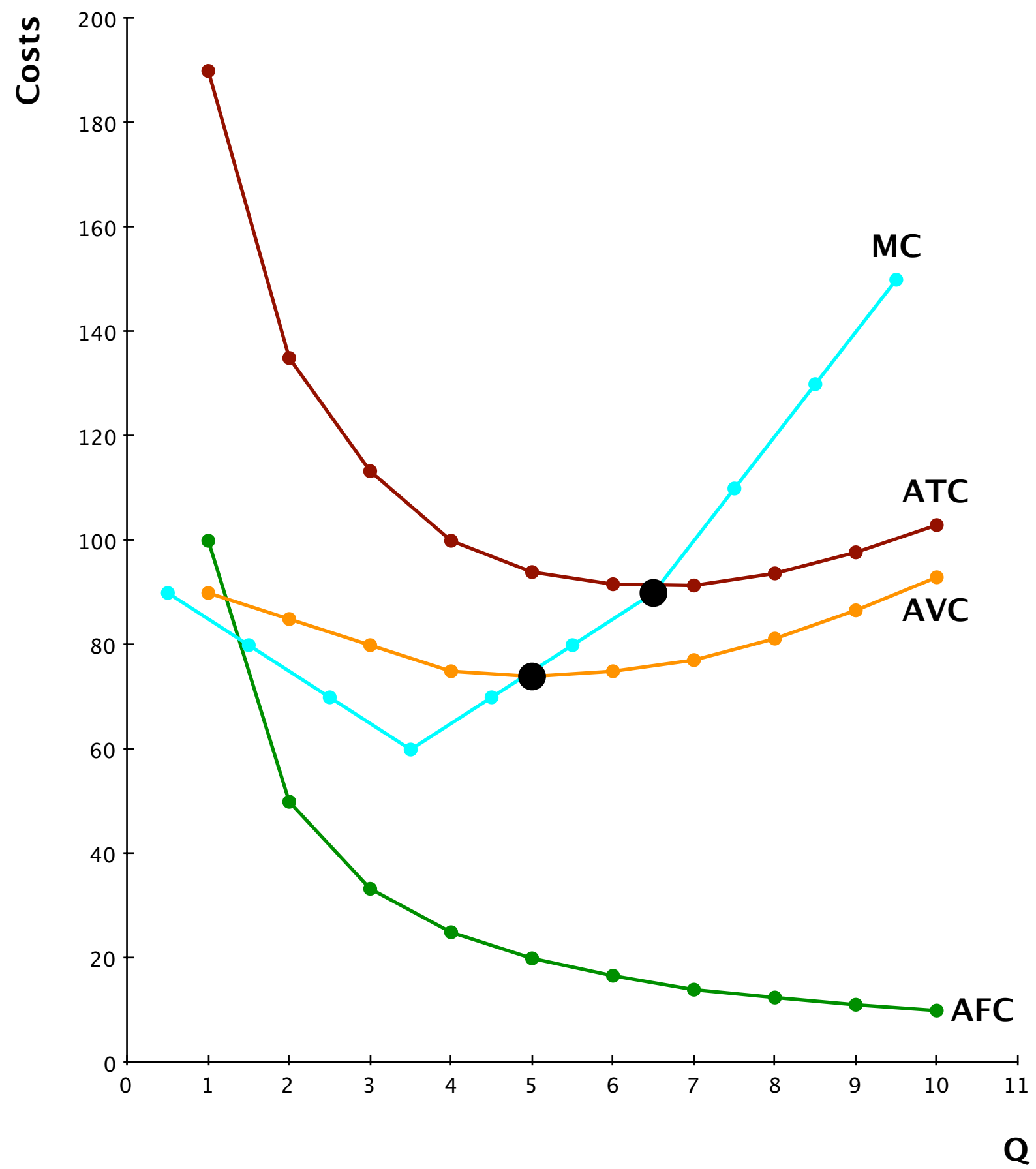




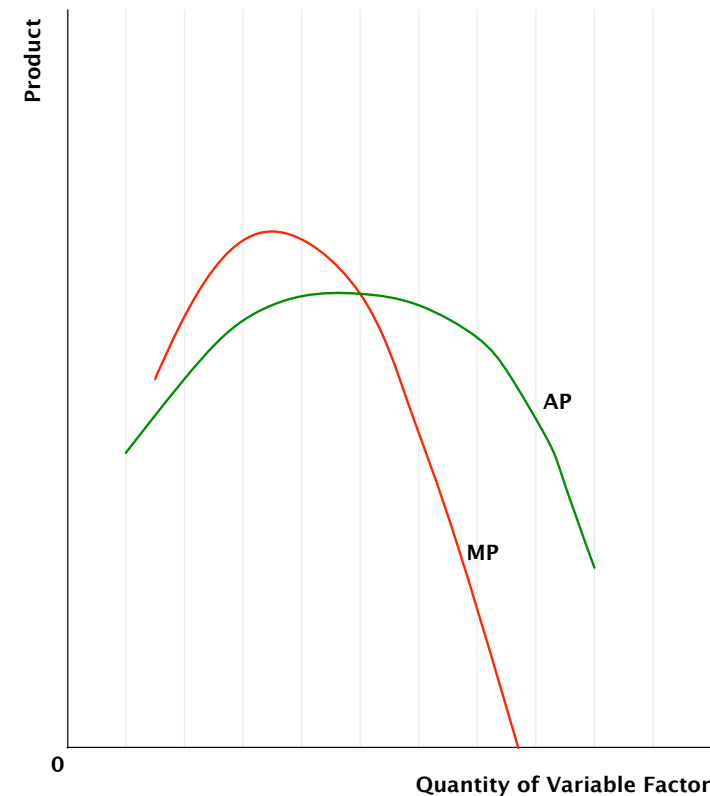




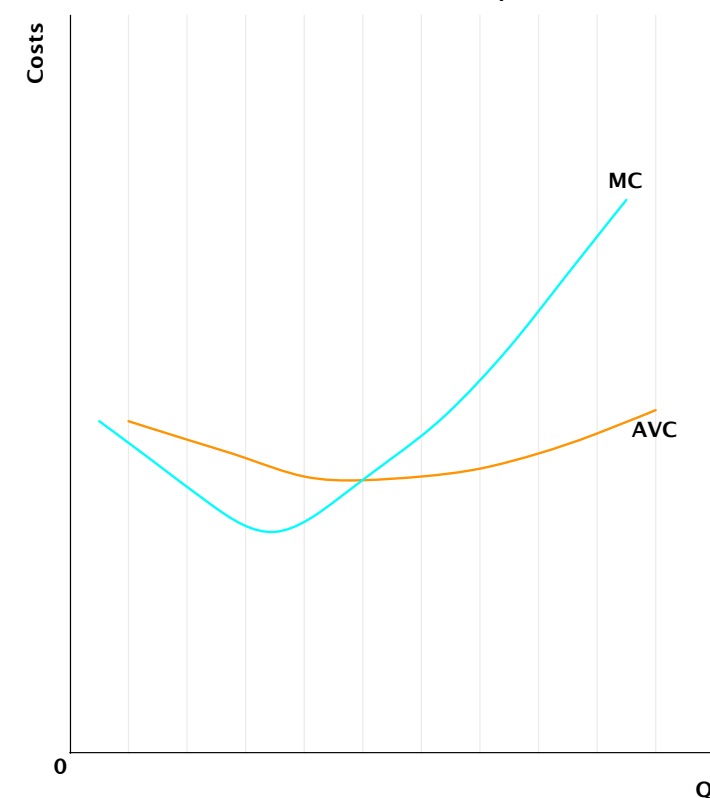
MC crosses AVC and ATC at their minimums!  
When MC is less than AVC/ATC, AVC/ATC falls.  
When MC is more than AVC/ATC, AVC/ATC rises.



Productivity →



Costs →



## NOTICE:

If  $MP > AP$  then  $AP \uparrow$

If  $MP < AP$  then  $AP \downarrow$

MP intersects AP at the maximum of AP

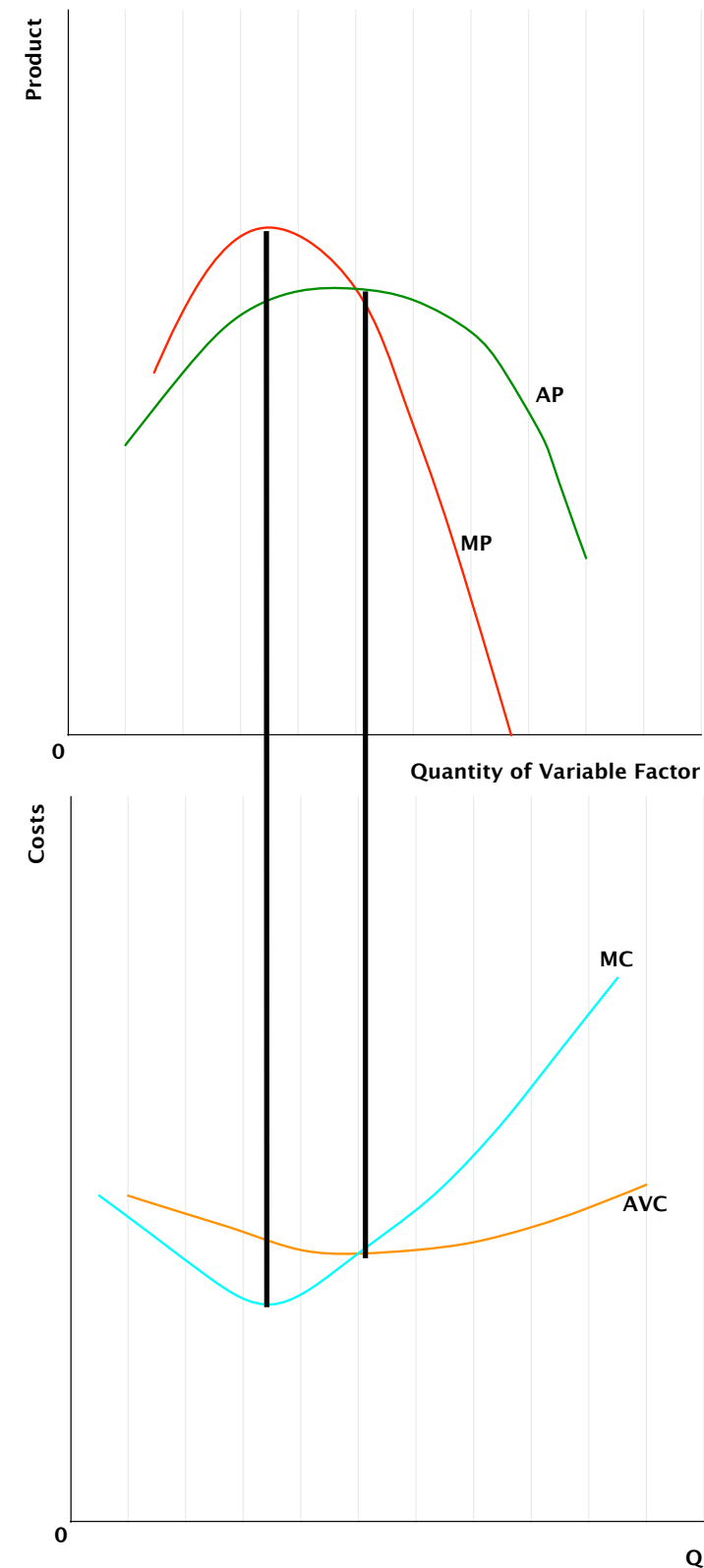
If  $MC < AVC$  then  $AVC \downarrow$

If  $MC > AVC$  then  $AVC \uparrow$

MC intersects AVC at the minimum of AVC

When MP is at its maximum, MC is at its minimum.  
When MP is rising, MC is falling.  
When MP is falling, MC is rising.  
When MP crosses AP, MC crosses AVC.

Productivity →



Costs →

**NOTICE:**

As  $MP \uparrow$ ,  $MC \downarrow$

As  $MP \downarrow$ ,  $MC \uparrow$

When MP is at its maximum, MC is at its minimum.

When MP crosses AP, MC crosses AVC.